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(54) Cheese substitute compositions

(57) The undesirable taste and the lack of the usual cheesy taste of the compositions are avoided by including in known compositions proteolytic enzyme clotted milk protein. The cheese substitute composition is a congealed mixture of milk-derived protein, vegetable fat and water where the ratio of protein to fat is from 1:4 to 4:1 and the ratio of water to the combination of protein and fat is from 1:3 to 4:1 by weight, the milk derived protein being at least in part the proteolytic enzyme clotted milk protein. The composition may include a citrate, monophosphate or polyphosphate emulsifi r and a food acid. The proteolytic enzyme may be rennet or pepsin type enzyme. The fat may be coconut, soy, safflower, corn, cotton or peanut oil. The proteolytic enzyme clotted milk protein may be mixed with other proteins, such as casein.

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SPECIFICATION

Cheese substitute containing clotted milk protein

The present invention relates to a cheese substitute and/or extender and method for production and use thereof. More particularly, the invention relates to a cheese substitute and/or extender which exhibits both the texture and the background cheesy flavor of natural cheese.

There has been considerable effort in the art to provide cheese substitutes. The consumption of cheese has significantly increased in recent years and the cost and uncertainty of supply has correspondingly increased. Additionally, the intake of saturated fats, as contained in natural cheese, must be limited for certain dietary considerations.

The cheese substitutes which have been more widely accepted can be characterized as those substitutes which are a mixture of milk derived protein, vegetable fat and water. Since these ingredients do not inherently form a homogenous solid at usual ratios and temperatures, provisions must be made in the cheese substitute for causing homogenization of these ingredients. One approach in the art has been that of adding gums to the composition, e.g., natural and synthetic gums such as gum arabic, guar gum and the like. In general, however, the gums tend to produce a rubbery texture in the cheese substitiute which renders the substitute unacceptable for many uses. Also, when heated these substitutes tend to form an undesirable gritty and grainy texture. Even when not heated the rubbery texture is totally uncharacteristic of cheeses such as cheddar cheese, Swiss cheese, Italian cheese, brick cheese, colby cheese, and mozzarella cheese.

The art has suggested a number of sources of protein for the cheese substitutes but, generally, the more successful cheese substitutes contain a milk derived protein. These proteins give nutritional values similar to cheese and are, generally, sufficiently inexpensive so as to produce acheese substitute at a lower cost than the natural cheese. A preferred milk derived protein in this regard is sodium caseinate, which is commercially available at a relatively low price.

Sodium caseinate, as well as acid casein and related products, produce an objectionable taste in the cheese substitute. When the cheese substitute contains casein, the well known "astringent" taste of acid casein is experienced during mastication and both the acid casein and sodium caseinate leave the well known "casein" after-taste in the mouth. Accordingly, even with these more successful cheese substitutes, the texture and taste are less than desired and these substitutes are not generally used in food compositions which contain higer proportions of cheese. Most uses are in compositions which are low proportions of cheese where the objectionable taste and texture is significantly diluted in the food compositions.

A very significant improvement providing milk derived proteins is described in U.S. application Serial No. 658,096, entitled BLAND NEUTRALIZED CASEIN, which application is a continuation of application Serial No. 455,511, filed on March 27, 1974. That application described a particular neturalized casein wherein the characteristic casein taste is essentially totally eliminated and the resulting casein is exceptionally bland to the taste.

In U.S. application Serial No. 455,501, filed on March 27, 1974 and now U.S. patent 3,918,854, a cheese extender is disclosed which uses the bland neutralized casein of the above-identified application. That cheese extender, in turn, has an exceptional bland taste. That cheese extender, however, by virture of its specific composition not only avoids the objectionable taste of prior cheese substitutes, due to the protein source, but also provides physical characteristics which are consistent with natural cheese, e.g.,provides a stringy nature similar to natural mozzarella cheese and the like. This composition is based on effecting a conquealing of fat, water and the bland neutralized casein of the above-identified application. That congealed mixture requires no gums or the like and therefore avoids the rubbery texture of prior compositions. While this cheese extender has enjoyed substantial commercial success, the taste of the cheese extender is quite bland and as pointed out by that patent the cheese extender is normally used in combination with the corresponding natural cheese or an artificial cheese flavor in order to impart the cheese flavor to the cheese substitute. Ratios between the cheese extender and natural cheese of 1:2 and 2:1 are preferred, although for certain applications the bland cheese extender alone may be used, i.e., where the other flavors of the food composition predominate over the cheese flavors in the food composition.

As is well known in the art, cheese produces at least two distinct flavors in masticating the cheese. The first important flavor is the characteristic flavor of the specific cheese. For example, by virture of the organisms which predominate in the cheese, th characteristic flavor of cheddar cheese, swiss cheese, lindberger cheese, and the like become immediately apparent in masticating the particular cheese. Aside from these specific cheese flavors, the cheese also contains an important flavor referred to in the art as the "cheese background flavor" or the "cheesy" flavor associated with all cheeses. For many applications of cheese, a mild specific flavor is quite acceptable, but the additional lack of any background flavor produces unacceptable results in the food composition. For example, in a pizza, the mild flavor of mozzarella cheese is often lost in the competing spice and tomato flavors but the overall background flavor of cheese is apparented in masticating the pizza. This cheese background flavor is absent in the ch ese extender described in the above-identified patent and th lack of that background flav r is objectionable to some consumers.

In many food compositions, the characteristic to be mimicked by the cheese substitute is the characteristic of the melted cheese. For example, the important charact ristic in a pizza is the stringy and translucent [illegible] of the melted cheese. The cheese substitute described in the above-identified patent w ll mimics

those characteristics of the melted cheese. However, for other purposes the characteristics of the uncooked cheese are important. For example, in wedge form for eating, in shredded or grated form for use in salads, and the like, the physical characteristics of the uncooked cheese are important. The cheese substitute of the above-identified patent can be shredded or grated or cut into wedge form for eating, but those subdivided forms do not mimic as closely as desired the cur ot torn texture of natural cheese. For example, when a wedg of natural mozzarella cheese is torn apart, the tear line shows a "fibrous" textured appearance. This appearance is important for eye appeal in certain foods using the uncooked cheese. Additionally, when mozzarella cheese is shredded for uncooked use, the shredded natural cheese has a clean and uniform sliced edge. Here again, this appearance is important for some uncooked food. Fok example, when forzen pizza is examined by a prospective customer, the appearance of the shredded cheese on the pizza is often important in the customer selecting between competing frozen pizzas. Pizzas which do not have the characteristic shred of high quality, natural mozzarella cheese are less appealing than the pizzas with shredded cheese having the appearance of high quality mozzarella shredded cheese.

Accordingly, it would be a significant advantage in the art to provide a cheese substitute which does not have an objectionable casein or caseinate taste but on the other hand is not devoid of a cheezy background flavor. It would further be of advantage in the art for the cheese substitute to provide the desired physical characteristics and texture in both the cooked and uncooked form.

It is therefore an onject of the present invention to provide a cheese substitute (or extender) which does not have the disagreeable casein or caseinate taste (or any other objectionable taste) but yet provides the background cheese flavor of natural cheese. It is a further object of the invention to provide such substitiutewith the said background flavor which may be additionally flavored, as desired, to mimic the total flavor of natural cheese, ranging from the very mild mozzarella cheese to the heavily flavored Italian cheese. It is a further object of the invention to provide such cheese substitute where both the cooked and uncooked characteristics and textures closely resemble the characteristics and textures of the cooked and uncooked natural cheese. It is yet a further object of the invention to provide various forms of the cheese substitute and food compositions containing the cheese substitute. Finally, it is an object of the invention to provide methods for the producing and use of the cheese substitute. Other objects will be apparent from the following description and claims.

The present invention is based on a primary discovery. It has now been determined that the prior cheese substitutes using milk derived protein lacked the conventional background cheese flavor because that background cheese flavor is not associated with the conventional milk derived protein but is associated with the products of proteolytic enzymatic digestion of those milk derived proteins. Thus, in order to provide the desired background cheese flavor, the heretofore used proteins must be at least in part digested by proteolytic enzymes.

The invention is also based on a subsidiary discovery. In producing the enzymatic digestion product, the physical functionality required for the cheese substitute can be achieved only when the enzymatically digested protein is in a "clot" form. In this regard, a clot is defined as being a discrete particle of enzymatically digested milk derived protein. It is not a suspension, solution or emulsion, although the clots per se may be discretely suspended by appropriate means. When clots of the proteolytic enzymatically digested milk derived proteins are used in the compositions, the composition will congeal in the manner described in the above-identified patent, and the congealed compositions exhibit both the texture and the background cheese flavor of natural cheese, essentially both in the cooked and uncooked form.

Thus, in the broadest sense the invention relates to a cheese substitute composition which is a congealed mechanical mixture of milk derived protein, fat and water where the ratio of protein to fat is 1:4 to 4:1 and the ratio of water to the combination of protein and fat is from 1:3 to 4:1, i.e. the solids content is at least 25%, calculated as the protein and fat being total solids. The improvement of the inventionis where the milk derived protein is at least in part proteolytic enzyme clotted milk protein, whereby the congealed composition exhibits the texture and background cheese flavor of natural cheese.

The clotted protein used in the present invention will provide its unique functions to a wide range of cheese substitute material, including those cheese substitutes which use a gum or like thickening or solidifying agent, although in those cases the characteristic rubbery texture of those cheese substitutes will remain. Th clotted protein, however, is primarily applicable to those cheese substitute materials which are congealed mechanical mixtures of protein, fat and water. In this regard the term "mechanical" means that the protein, fat and water are added as individual ingredients and blended in to a physical mixture where the protein, fat and water are visibly detectable as different phases (ingredients). Correspondingly, the term "congealed" means that the mechanical mixture is converted to a homogeneous mixtur with no visibly detectable different phases, i.e., the water, protein and fat are not in visibly, discernably different phases. Accordingly, the term congealed does not include a mechanical mixture of the ingredients and indeed the composition is best described as a gel. While not bound by theory, it appears that the pres nt protein is sufficiently solvated by water to act as a semi-solid mulsifier for the fat and water, i.e., it is g lable. Thus, th clotted prot in used in the practic of this inv ntion must be capable of producing a gel of the d sired ingredients.

On the other hand the fat used in the ch ese composition is not narrowly critical and usually is chosen from any of the conventional vegetable fats. Animal fat will function in the same manner as vegetable fats, but animal fat tends to induce its own flavor into the cheese composition and presents problems in preserv-

ing the cheese substitut . Accordingly, animal fat is not a commercially practical embodiment of the invention. The vegetable fat may be chosen from any of the conventional fats such as derived from coconuts, soy beans safflowers, corn, cotton, peanuts, etc., either hydrogenated or non-hydrogenated. However, relatively low melting point vegetable fats are preferred, and it is further preferred that the vegetable fat be chosen from those having a more bland taste, e.g., soy bean oil and corn oil. Preferably, the melting point of the fat should be less than 55°C and preferably the melting point is between -6.5°C and 52°C especially between 10°C and 49°C.

The relative proportions of the clotted protein to fat can vary widely and, as can be appreciated, will d pend primarily upon the particular cheese being mimicked. Generally speaking, these proportions will be consistent with the higher or lower proportions of protein to fat in the natural cheese, although the proportions will not necessarily be the same. For example, for a soft cheese, such as cream cheese, the ratio will be relatively low, i.e. as low as 1:4. On the other hand, where the cheese to be mimicked is a hard and tough cheese, such as highly aged Parmesan cheese, then the proportions of protein to fat will be relatively high, i.e., as high as 4:1. It should be appreicated, however, that these proportions are in regard to the natural cheese and if it is intended to mimic a cheese product, e.g., a cheese sauce, then proportions outside of this range may be used. In a sense, these greater ranges provide proportions for producing the mimicked cheese and additional proportions for then converting the mimicked cheese into a mimicked cheese product. For example, a cheese cause, may use a protein to fat weight ratio as low as .5:4.

Correspondingly, the ratio of water to the combination of protein and fat will vary depending upon the particular cheese being mimicked. Thus, when mimicking a low moisture content cheese, such as highly aged Parmesan cheese, the ratio of water to the combination of protein and fat may be as little as 1:3. On the other hand, when mimicking a high moisture content cheese, such as low solids unaged mozzarella cheese, the ratio of water to the combination of protein and fat may be high, e.g., 4:1. Similarly, when it is intended to mimic a product of the cheese, ratios outside of this range may be used. Thus, if it is intended to mimic a cheese fondue, then the ratio of water to the combination of protein and fat could be as high as 7:1.

In both of these regards, however, it is preferred that the ratio of protein to fat be from 1:3 to 3:1 and more preferably from 1:2 to 2:1. When the ratio is between 1:1.5 and 1:1.1, the best results for most mimicked cheeses will be achieved. Similarly, it is preferred that the ratio of water to the combination of protein and fat be from 1:2 to 3:1 and especially from 1.5:1 to 1:1.5. Best results are achieved at ratios between 1.25:1 and 1:1.25.

The remainder of the ingredients of the compositions may be as desired. However, the combination of protein and fat should comprise at least 50% of the total solids of the cheese substitute composition, preferably at least 60 to 75%, and more preferably at least 90 to 92%. The remaining ingredients can be conventional flavorings, certified food colorings, preservatives, etc. Examples of the foregoing are salt, lactic acid or lactates, butter oils, especially lipolyized butter oils, titanimum dioxide, carotene, imitation and natural cheese flavors and natural cheese. While not preferred, conventional bulking agents or fillers may be used with the present cheese substitute, including conventional acid casein and caseinates, e.g., acid casein, sodium caseinate, potassium caseinate, and calcium caseinate, although if substantial amounts of these fillers or bulking agents are used, objectionable flavors, as noted above, will result.

The entire congealable protein of the composition may be the proteolytic enzyme clotted protein, or that clotted protein may form only part of a congealable protein. The remainder of the congealable protein may be chosen from conventional proteins, such as casein or caseinates, as described above, and including the bland magnesium caseinate or potassium caseinate of the above-identified U.S. application. However, to achieve the desired physical characteristics and background cheese flavor, the present clotted protein should comprise at least 25% of the congealed protein of the cheese substitute composition and more preferably at least 50% thereof.Ideally the clotted protein will comprise at least 75% of the congealed protein and for best results the clotted protein will be 100% of the congealed protein of the cheese substitute composition.

As noted above, in order to achieve the desired functionality, the clotted protein must have clot characteristics such that it is a discrete clot. If the enzymatic digestion has not proceeded to the point that a discrete clot is formed, then the digestion has not produced sufficient digested product to provide the desired background cheese flavor. Additonally the desired physical functionality of texture and appearance will not be achieved in the cheese substitute. This is particularly true when the protein of the cheese substitute is not all clotted prot in.

On the other hand, the enzymatic digestion must not proceed to the point that the clot characteristics are lost. In this case, digestion would have proceeded to the point that the desired texture and appearance will not be achieved in the cheese substitute and indeed with further such digestion a congealed mixture will not be achieved. Further, the increased digestion tends to produce undesired flavors. Accordingly, for purposes of the present specification and claims, these clot characteristics of the clotted protein are defined as those clots which are shaped sustaining and filterable, i.e., when separated or merely suspended, th clots will retain, essentially, their shape and can be separated from a suspension by ordinary filtration techniqu s, i.e., filter paper, filter cloth, centrifuging, and the lik .

So long as the above characteristics are achieved, th particular nzyme is not critical. Thus the cl tted ay be the enzymatic product of milk protein digested by an animal derived, vegetable derived or

microbial derived enzyme. However, since the enzymatic digestion is for the purpose of advantageously converting the protein, it is preferred that the enzyme is substantially only a proteolytic enzyme. In this case, should other substituents be associated with the protein being enzymatically digested, e.g., fat, those additional ingredients will not be enzymatically digested with the possibility of producing off flavors, particularly in the case of associated fat. To achieve this specificity of enzymatic reaction, the more conventional animal or microbial enzymes are preferred, e.g., rennet and pepsin type enzymes.

For the same reason noted in the foregoing paragraph, it is preferred that the clotted protein be derived from skim milk, since this minimizes the possibility of contaminating flavors, i.e., enzymatic derived fat flavors. However, whole milk, dry milk solids, skim milk solids, casein and caseinates may be used, although not preferred.

The general process for enzymatically digesting milk derived proteins is well known in the art and need not be described herein for sake of conciseness. Briefly stated, however, a suspension of the desired milk derived protein is simply treated with an appropriate enzyme and sufficient time is provided for the enzyme is achieve the desired degree of digestion. This time will vary depending upon the particular protein and the particular suspension thereof, as well as the particular enzyme and the temperature of enzymatic digestion. Generally, the temperature can be up to the point of denaturization of the protein and/or deactivation of the enzyme and as low as solidification of the protein suspension and/or the essential lack of activity of the enzyme. Generally speaking, between approximately -1°C and 82°C, adequate enzymatic reaction will take place, but more usually these processes are carried out between about 10°C and 49°C. If a conventional casein or caseinate is used as the protein source, e.g., acid casein, sodium caseinate and the like, provisions should be made to allow enzymatic digestion to take place. For example, when the casein is the protein source, then a suspension thereof should be made in order to give adequate opportunity for the enzyme to react with the protein. When natural suspensions are used, such as skim milk, then milk protein is in a favorable condition for quick and accurate enzymatic digestion. Skim milk also has a low level of fat and for these reasons is the preferred protein source for the clotted enzyme. By way of illustration, therefore, skimmed milk at room temperature is treated with rennet enzyme, in usual concentrations, and the enzyme is allowed to digest the protein until clotting commences. The enzymatic digestion is then closely followed and when clotting has been essentially completed (little further clotting takes place), the clot is removed from the suspension, e.g., filtered, centrifuged, decanted, drained, and the like. Preferably, the enzyme is deactivated by conventional manners, preferably simply by heat, i.e., at temperatures of about 85°C or greater. This curd is then both shape sustaining and filterable and is quite acceptable as the clotted protein in the present composition. Indeed, clotted protein made, essentially, accordingly to the foregoing described process, is commercially available. Heretofore its uses have been for conventional dairy compositions, e.g., ice cream, etc. The recovered clotted protein may be dried or it may be used in its wetted form in the present composition, although for storage stability it should be dried or pasteurized. In this case, the clotted protein is produced separately from the composition and added to the composition when the composition is prepared. On the other hand, it should be appreciated that the clotted protein may be produced in situ in the composition. Thus, when the suspension of protein is totally added to the composition, the enzyme may also be added to the composition to produce the clotted protein in situ in the composition. In this case, normally, the amount of water associated with the suspension of the protein, e.g., the water in skim milk, should be within the range anticipated for the composition. Thus, the water suspending protein (e.g., the water of the skim milk) will be the water for producing the cheese substitute composition and the clotted protein will be produced in situ. This, however, is not a preferred form of the invention.

The composition is prepared by mixing the clotted protein, fat and water until a homogenous mixture is obtained and congealing of the mixture at least commences. In this regard, the term "homogenous" is defined to mean that the mixture does not have discrete proportions or phases of the protein, fat and water. It is necessary to continue and mixing until congealing at least commences. The clotted protein, under appropriate conditions, can commence congealing of the present ingredients without any special procedure being followed, as opposed to the congealing accomplished in the above-identified patent. It is believed the enzymatic digested protein is in a form which is more easily solvated by water than the form of the protein in the above-identified patent and adequate congealing for some cheese substitutes can be achieved by simple mixing. This is, of course, an additional and important feature of the present invention.

Of course, the requisite time for accomplishing a congealing of the mixture will depend upon the mode of mixing and the temperature of mixing. While any desired form of mixing may be used, including paddle mixers, blenders, shearing mixers, roller mixers, and the like, a simple beater mixer or even a home mixer such as MIXMASTER may be used. Similarly, mixing speeds are not critical and may be as desired, so long as the homogenous mixture is obtained. Temperature, on the other hand, will effect mixing time. The lower the temperature, the longer the mixing time required. While the temperature can be low as the solidification point of the mixture, and as high as the boiling of the liquids associated with the mixture, for convenience the mixing is carried out at a temperature between at least 1°C and no more than 99°C. Most conveniently, mixing is conducted simply at about room temperature. However, there are advantages in mixing at elevated temperatures, since the speed of reaching a homogenous mixture and the commencement of agitation will be increased. Additionally, if the mixing temperatures are sufficiently high, pasteurization of the product will also take place during mixing, which is an additional important feature of the invention. Thus, for speed of mixing, mixing temperatures of between 55°C and 93°C are preferred, and to insure pasteurization,

mixing temperatures of at least 77°C are necessary. Longer mixing times at higher temperatures, i.e., temperatures beyond 99°C, should be avoided since denaturization of the protein can commence at those higher temperatures.

With the higher temperatures, mixing to a homogenous condition and to the point that congealing commences can be achieved in as little as 2 minutes, but more usually the mixing is carried out at least 4 minutes. Longer mixing times may be advantageously used, e.g., a half hour to one hour and a half, but there is no advantage in significantly longer mixing times, especially over three hours.

As noted above, it is only necessary to continue the mixing until congealing commences. At this point, the shape sustaining properties of the mixture will be achieved, although those properties will not be fully developed. In order to fully developed those properties the mixing is continued until the mixture is congealed to a non-flowable state at room temperature. In other words, the mixture can not be poured at room temperature. This does not means that when left at rest the mixture will not eventually cold flow but that it is simply nor pourable. When the mixture is congealed to a non-flowable state, the mixture may then be shaped into a form, e.g., a cheese wedge, a cheese ball, etc.

When the congealed mixture is formed into a shape, that shape can be further treated to render the congealed mixture into yet another form. For example, a wedge form may be grated or shredded so as to render it in a form suitable for use in foods, e.g., pizza, macroni and cheese, cheese sauces, etc. Additionally, if desired, the cheese substitute may be molded into specific decorative shapes, e.g., the shapes of animals, playing card suits, etc. If may be also formed into a dispersion for flavoring food products, such as corn curls and the like.

The speed and convenience of mixing the ingredients to a congealed mixture can be increased by the use of an emulsifier, which is added to the mixture prior to mixing. While any food-grade emulsifier may be used, the "processed cheese emulsifiers" are preferred, since these emulsifiers are food-grade and the use thereof is well known to the art. Particularly preferred are the citrates, monophosphates and polyphosphates emulsifiers, e.g., orthophosphoric acid, mono-, di and tri sodium or potassium or ammonium or calcium phosphate, sodium aluminum- or mono aluminium- phosphate, mono- and tri- magnesium ohosphate, sodium acid pyro phosphate, tetra sodium or potassium pyro phosphate, sodium or potassium tri-polyphosphate, sodium tetrameta- or hexameta- phosphate, potassium metaphosphate, sodium citrate or mono- and di- glycerides.

Either with or in lieu of emulsifiers, a favourable acid/base balance can increase the ease of mixing and the degree of homogenity which results. Thus, lactic acid/sodium hydroxide, citric acid/magnesium hydroxide, etc., may form useful buffers. Indeed, an alkaline earth metal salt, oxide or hydroxide congealing agent, e.g., magnesium oxide, as disclosed in U.S. patent 4,031,254 is advantageously used.

While the pH of the mixture, either prior to or after congealing, may vary widely, it is preferred that the pH be on the acidic side, since this tends to provide better flavors and stability of the congealed product. Particularly, a pH of between 4 and 7 seems to be optimumand that pH can be achieved by adding to the mixture and a food-grade acid or base to correspondingly adjust to the pH. Any of the food-grade acids or bases may be used, particularly the mineral acids, citric/lactic acids, etc., and the alkali and alkaline earth bases, e.g., sodium hydroxide, potassium hydroxide, magnesium hydroxide, and the like. It has been found, however, that lactic acid has an additional advantage of increasing the functionality of the congealed mixture of mimicking certain cheeses, e.g., the stringiness of mozzarella cheese and for this reason lactic acid is the preferred acid for adjusting the ph.

Of course, prior to mixing one or more of preservatives, flavors, colorings salts, nutritional supplements and the like may be added. These are conventional in the art and will not be described in detail herein for sake of conciseness.

The congealed mixture may be converted to a dried form if desired simply by drying in a conventional manner, e.g., roller dryers, try dryers and the like. Alternatively, the congealed mixture may be macerated, suspended in a liquid and spray dried to a powder. Drying of the congealed mixture will, of course, provide shelf stability and the congealed mixture may be reconstituted simply by mixing again with water to provide the congealed form. The dried form is convenient for mixing with a food stuff to provide a food composition, i.e., dried macaroni and cheese, for reconstitution and preparing at the home. Of course, the congealed mixture itself may be admixed with the food stuff to provide a food composition, but some means, such as freezing, will be required to provide shelf stability. For example, where the food composition is a pizza, the congealed cheese substitute may be shredded and placed on the pizza, but the packaged pizza must be frozen in order to provide shelf stability.

When it is desired to provide a shelf stable product which can be reconstituted in the home to provide a cheese wedge or the like, the clotted protein and fat are first mixed to a dry form without the water being added at that time. This dry form is then packaged and supplied to consumers for reconstitution by the consumer, Thus, the consumer will subsequently add the necessary water to the dried form and mixing, in the same manner described above, will be carried until the homogenous mixture is obtained and congealing of the mixture at least commences. Thus, by this method the dry ingredients may be kept on the shelf, for example, in the home and re-constituted to form a cheese wedge as required. This, of course, is a substantial advantage in that a shelf stable form of cheese substitutes will be available to the householder. Of course, once the cheese substitute is reconstituted, refrigeration will be required for storage.

As can be appreciated, in preparing a cheese substitute to mimic a specific cheese, processing steps and

conditions may be varied to enhance certain properties. For example, the stringy characteristic of melted mozzarella cheese is most difficult to mimic in a cheese substitute. That stringy characteristic is a result of very special viscoelastic properties in the mozzarella cheese and this property is shared by few other cheeses. Since this is the most difficult property to mimic, and since mozarella cheese substitute is an important feature of the invention, the following description and example will be specific to a mozarella cheese substitute, although it is to be understood that the invention extends to the scope described above. In the Examples, as well as in the foregoing description, all percentages and parts are by weight unless oth rwise designated.

EXAMPLE 1

To achieve the stringiness associated with mozzarella, it is important that an exceptionally homogenous mixture of the clotted protein, fat, water and additional ingredients be achieved. Increased homogeneity can be produced by several different processing steps and conditions.firstly, increased mixing temperatures promote increased homogeneity. Secondly, the use of emulsifiers and favorable pH ranges increase solvation of the protein and promote homogeneity. Thirdly, the length of mixing and the precise kind of mixer can promote homogeneity, although this is of less importance than the foregoing for promoting homogeneity. Lastly, the order of addition of the ingredients and the physical form of the ingredients, e.g., the particle size of the clotted protein, can effect homogeneity. The following will illustrate the effects of some of the processing conditions for promoting greater homogeneity and the desired stringiness, as well as other characteristics, of mozzarella cheese substitute. In this Example, the term "rennet casein" is used to indicate that the clotted protein of the invention has been commercially purchased and is the clotted protein derived from clotting with the rennet enzyme. Most commercial sources of rennet casein are Australian and New Zealand rennet casein. It should be understood, however, that this terminology does not imply that the material is "casein" and it should be fully understood that the protein used is the enzymatically digested protein.

FORMULA A

Ingredient	*Percent*
Rennet casein	28.0
Fat(CIROL, 38-43°C)	21.2
NaCl	1.4
Polyphosphate emulsifier (KASAL)	3.0
Sodium citrate	0.5
Lactic acid (88%)	1.8
Potassium sorbate (perservative)	0.1
Water	44.5

Test 1

The fat was placed in a Groen kettle and heated to 66°C to melt the fat. The rennet casein was disbursed with agitation and water heated to 55°C was mixed with further agitation. The temperature dropped during the mixing to 43°C and the product thickened to the consistency of mashed potatoes. The temperature was raised to 71°C for 40 minutes. No change in the product was observed. The product did not exhibit the desired exceptional stringiness of mozzarella cheese.

Test 2

T st 1 was repeated except after completion of further mixing at 71°C, the phosphate emulsifier, sodium citrate and lactic acid (pH adjustment) were added, along with the salt and preservative. The temperature was raised to 82°C and the product rapidly smoothed and became more homogenous. The product, when completely congealed and subsequently melted product strings in the nature of mozzarella cheese.

Test 3

In this test the following formula was used:

FORMULA B

Ingredients	*Percent*
Renn t casein	24
Fat*(CIROL, 38-45°C melt)	22
NaCl	2
Polyphosphate emulsifier (KASAL)	.4
Sodium citrate	2.0
Lactic acid (88%)	1.5
Potassium sorbate	0.1
Water	48

* Contains 0.5% lecthin

The fat was melted in a Groen k ttle at 150°F and the renn t casein was blended therewith. The remaining ingredients were dispersed in the water and added to the kettle at 74°C. After 15 minutes of mixing at that temperature, the product was very fluid and gritty, little thickening had taken place. At 20 minutes of mixing some thickening began and at 30 minutes the product was very thick. However, the product would not string in the nature of mozzarella. The temperature was raised to 77°C and mixing was continued for additional 15 minutes. The product smoothed out, became very thick and the product would string in the nature of mozzarella cheese.

Test 4

In this test formula A above was used. Fat was melted in the Groen kettle at 49°C and the rennet casein was dispersed therein. The remaining ingredients, with the exception of the acid, were dispersed in water at 54°C and added to the dispersion of rennet casein and fat. An immediate thickening occurred. After 5 minutes of mixing at 60°C, the product smoothed. After a total of 10 minutes mixing time the acid was added and the temperature was increased to 74°C. After thorough mixing, the product was recovered and cooled. The product was smooth, very homogenous and would stretch in the nature of mozzarella cheese.

Test 5

The formula of A above was again used (with the exception of two additional percents of water being used - a total of 102.5%). In this test the fat and protein were blended in a silent chopper (a relatively high speed slicing and chopping machine) for 1 to 2 minutes. The emulsifier, salt, and sorbate were also blended in the chopper. This pre-blended product was then placed in a Groen kettle and the water and acid were added thereto with heating to 82°C. After approximately 15 minutes of mixing, the product was smooth and thick and exhibited the stringy characteristics of mozzarella cheese.

EXAMPLE 2

Preparation of Pizza

Traditional pizza dough was prepared by mixing flour, salt, solid vegetable shortening, scalded milk and dried yeast. The dough was allowed to raise in the conventional manner and rolled into an unbaked pizza crust. The crust was lightly brushed with olive oil and traditional pizza sauce was placed thereon. The sauce was prepared by mixing mascerated tomatoes, minced garlic, minced onion, olive oil, oregano, freshly ground black pepper and red pepper flakes. Onto the pizza sauce was placed grated mozzarella cheese substitute, the product of Test 5 of Example 1.

Thereafter, the pizza was baked at 216°C for twenty minutes. The cheese of the baked pizza was white, of a milky translucent appearance and when pulled, stringed in a manner essentially the same as mozzarella cheese.

As a comparison, a pizza was prepared in the same manner as described above, except that all natural mozzarella cheese was used. The all natural mozzarella cheese pizza could not be distinguished from the pizza with the present substitute in terms of its appearance, stringiness, or other physical characteristics, as well as the cheese background flavor.

EXAMPLE 3

The following procedure was used in each of the following tests.

Melted fat, 60°C, was added to an auger type cheese cooker. Color and emulsifiers, when used, were previously dispersed in the fat. Hot water, 71°C, was added to the cooker. All salts and preservatives were previously dispersed in the water. One half of the rennet casein was added to the cooker with agitation. The addition of casein was halted and some of the product was removed from discharge port of the cooker and added back into feed hopper to eliminate rennet casein build-up at the discharge end. This was repeated until all of the rennet casein was added and dispersed. The lactic acid was then added and heat was applied by steam injection to raise product temperature to 79-82°C. Mixing was continued until the mixture congealed.

Test 1

In this test the following formula was used:

Ingredients	*Percent*
Rennet casein	29.5
Vegetable fat (CIROL)	18.0
Sodium aluminium phosphate(CASAL)	2.5
Sodium citrate	0.5
Salt	1.4
Lactic Acid (88%)	1.8
Emplex(emulsifier)	.01
Glyc rol monostearate	.04
Potassium sorbate	0.1
Hansen at-435-S (color)	.0015
Water	47.0

A mozzarella che se substitute was produced.

Test 2

In this test the following formula was used:

Ingredients	*Percent*	
Rennet casein	18.5	
Vegetable fat (CIROL)	22.2	
Trisodium phosphate dodecahydrate	2.0	
Sodium aluminum phosphate (KASAL)	1.0	
Salt	1.0	
Potassium sorbate	0.1	
N.F.D.M.	1.5	flavor
Sweet Whey	2.3	
Cheztone 101 (high cure cheese pow)	6.0	
Givaudan F 8920 (cheese flavor)	5.0	
Water	40.4	

An American cheese substitute was produced.

CLAIMS

1. A cheese substitute composition which is a congealed mixture of milk derived protein, vegetable fat and water, where the ratio of protein to fat is from 1:4 to 4:1 by weight and the ratio of water to the combination of protein and fat is from 1:3 to 4:1 by weight, the milk derived protein being at least in part proteolytic enzyme clotted milk protein, whereby the congealed composition exhibits the texture and background cheese flavor of natural cheese.

2. The composition of claim 1 wherein the clotted protein has clot characteristics such that clots thereof are shape-sustainable and filterable.

3. The composition of claim 1 or 2 wherein the clotted protein is the enzymatic product of milk portein digestion by an animal derived, vegetable derived or microbial derived enzyne.

4. The composition of claim 3 wherein the enzyme is substantially only a proteolytic enzyme.

5. The composition of claim 4 wherein the enzyme is a microbial derived enzyme.

6. The composition of claim 5 wherein the enzyme is microbial rennet.

7. The composition of any one of the preceding claims wherein the clotted protein is derived from skim milk.

8. The composition of any one of the preceding claims wherein the clotted protein is produced *in situ* in the composition.

9. The composition of any one of Claims 1 to 7 wherein the clotted ptotein is produced separately from the composition and added to the composition.

10. The composition of any one of the preceding claims which also contains an emulsifier.

11. The composition of claim 10 wherein the emulsifier is a processed cheese emulsifier.

12. The composition of claim 11 wherein the emulsifier is selected from citrates, monophosphates and polyphosphates.

13. The composition of any one of the preceeding claims wherein the pH of the congealed mixture is from 4 to 7.

14. The composition of claim 13 wherein the pH is adjusted with a food-grade acid or base.

15. The composition of claim 14 wherein the pH of the composition is adjusted with lactic acid.

16. The composition of any one of the preceeding claims which also contains one or more of perservatives, flavors, colorings, salt and nutritional supplementations.

17. The composition of any one of the preceeding claims in a pasteurized form.

18. The composition of any one of the preceeding claims in a dried form.

19. The composition of any one of the preceding claims in admixture with food-stuff to provide a food composition.

20. The composition of any one of the preceeding claims where food composition is pizza.

21. A method of producing a cheese substituent composition which comprises mixing a clotted milk derived protein which comprises proteolytic enzyme, vegetable fat and water, the weight ratio of protein to fat being from 1:4 to 4:1 and the weight ratio of water to the combination of protein and water being from 1:3 to 4:1, until a homogenous mixture is obtained and congealing of the mixture at least commences.

22. The method of claim 21 wherein the mixing is at temperatures of from 1 to 99°C.

23. The method of claim 22 wherein the temperature of mixing is from 53°C to 93°C.

24. The method of claim 23 wherein the mixing temperature is from 82°C to 93°C.

25. The method of any on of claims 21 to 24 wherein the mixing is carried out for at least 2 minutes.

26. Th method of claim 25 wherein the mixing is carried out for at least 4 minutes.

27. The method of any one of claims 21 to 26 wherein the mixing is continued until th mixtur is congealed to a non-flowable state and the congealed mixture is shap d into a form.

28. Th m thod of claim 27 wh rein the shap d form is grated or shredded or slic d.

29. The m thod f any one of claims 21 to 28 wher in the clotted pr tein has clot characteristics such that clots thereof ar shape-sustainable and filterable.

30. The method of any one of claims 21 to 28 wherein the clotted protein is the enzymatic product of milk

protein digestion by an animal derived, vegetable derived or microbial derived enzyme.

31. The method of claim 30 wherein the enzyme is substantially only a proteolytic enzyme.

32. The method of claim 31 wherein the enzyme is a microbial derived enzyme.

33. The method of claim 32 wherein the enzyme is rennet.

34. The method of any one of claims 21 to 23 wherein the clotted protein is derived from skim milk.

35. The method of any one of the preceeding claims 21 to 35 wherein the clotted protein is produced by adding the enzyme to a liquid suspension of milk protein in the composition.

36. The method of any one of claims 21 to 35, wherein there is included in the mixture a processed cheese emulsifier

37. The method of claim 36 wherein the emulsifier is selected from citrates, monophonsphates and poly phosphates.

38. The method of any one of claims 21 to 37 wherein the pH of the mixture is from 4 to 7.

39. The method of claim 38 wherein the pH is adjusted by adding to the mixture a food-grade acid or base.

40. The method of claim 39 wherein the pH of the composition is adjusted with lactic acid.

41. The method of any one of claims 21 to 40 wherein one or more of preservatives, flavors, colorings, salt and nutritional supplementations is added to the mixture.

42. The method of any one of claims 21 to 41 where the congealed mixture is further admixed with a food stuff to provide a food composition.

43. The method of claim 42 where the food composition is pizza.

44. The method of any one of claims 21 to 43 wherein the clotted protein and fat are first mixed to a dry form and packaged and subsequently the water is added to the dry foam and mixed until a homogenous mixture is obtained and congealing of the mixture at least commences.

45. A method of producing a cheese substitute composition, substantially as described in any one of the foregoing examples.

46. A cheese substitute composition as claimed in claim 1, substantially as described herein.

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